

Answer the following questions; assuming any missing data.

- 1) a- A uniform line charge of $\rho_l = 2 \text{ nC/m}$ lies along the y axis, while uniform surface charge densities of $+0.1$ and -0.1 nC/m^2 exist on the planes $z = 3 \text{ m}$ and $z = -4 \text{ m}$, respectively. Find E at the point $P(1, -7, 2)$. At which point is E the negative of the field at P ?
b- Given the electric field $E = (4x-2y) \mathbf{a}_x - (2x+4y) \mathbf{a}_y$, Find the equation of the stream line that pass through the point $P(2, 3, -4)$
- 2) a- State Gauss's law
b- A uniform volume charge density of $80 \mu\text{C/m}^3$ is present throughout the region $8 \text{ mm} < r < 10 \text{ mm}$. Let $\rho_v = 0$ for $0 < r < 8 \text{ mm}$.
 - 1- Find the total charge inside the spherical surface $r=10 \text{ mm}$,
 - 2- Find D_r at $r=10 \text{ mm}$, and
 - 3- If there is no charge for $r > 10 \text{ mm}$, find D_r at $r=20 \text{ mm}$.
- 3) Within the cylindrical region $\rho \leq 5 \text{ m}$, the electric flux density is given as $4\rho^2 \mathbf{a}_\rho \text{ C/m}^2$.
 - 1- What is the volume charge density at $\rho = 2 \text{ m}$?
 - 2- How much electric flux leaves the cylinder $\rho = 2, -5 \leq z \leq 5$?
 - 3- How much charge is contained within this cylinder?
- 4) Given $E = -x \mathbf{a}_x + y \mathbf{a}_y$,
 - 1- Find the work involved in moving a unit positive charge on a circular arc, the circle centered at the origin, from $x=a$ to $x=y=a/(2)^{1/2}$
 - 2- Verify that the work done in moving the charge around the full circle from $x=a$ is zero.
- 5) Two current filaments are parallel to the z -axis. One passes through $(0, 0.5, 0)$ and carries 100 mA in the \mathbf{a}_z direction; the other passes through $(0, -0.5, 0)$ and carries 100 mA in the $-\mathbf{a}_z$ direction. Plot H_x versus y , $0 < y < 2$ for points on the y -axis.
- 6) Three Infinitely long parallel filaments each carry 50 A in the \mathbf{a}_z direction. If the filaments lie in plane $x=0$ with 2 cm spacing between wires, find the vector force per meter on each filament.